that does not seem to have been heretofore observed. The first two are those marked *aa* and *bb*, which apparently are the upper bitangent arc of a halo of 46° and part of a "secondary" parhelic circle, respectively. At the intersections of these two arcs were observed bright spots which might be called "secondary" parhelia of 46°. The "secondary" parhelic circle was probably caused by the vertical parhelion at *c*, which in turn was produced by the intersection of the light pillar and the 22° halo.

The arcs *dd* are difficult to account for. Possibly they are parts of an "eliptical helio-centric halo," similar to that observed by Hissink in 1901, and referred to by Besson, MONTHLY WEATHER REVIEW, July, 1914, p. 445, top of column 1.—*W. R. Gregg.*

INFERIOR ARC OF 46°-HALO, APRIL 25, 1918.[1]

By J. LAKE VESPER, Assistant Observer.

[Dated: Weather Bureau Office, Columbus, Ohio, May 20, 1918.]

A very interesting and unusual[2] optical phenomenon in the form of a double solar halo was observed at this station, Columbus, Ohio, on April 25, 1918.

When first noted at 11:50 a. m., 90th meridian summer time [?], it was exceedingly well defined and evidently had been visible for some time previous. Its duration for attractive brilliancy lasted until 12:40 p. m., after which it gradually faded.

The time of day at which it occurred (the sun being almost at its maximum elevation in the sky) was most advantageous for the observation of the complete 22°-halo. It was accompanied by the *lower arc* of a 46°-halo, the arc measuring approximately 50° in extent. The brilliancy of the 22°-halo was well defined for the 360°, with the exception of the lower segment symmetrical with the arc of the 46°-halo. This segment had attained a very great brilliancy, causing the arc of the 46°-halo to be visible.

The latter lacked somewhat the brilliancy of the 22°-halo, but the color was well defined, with the blue predominating.

A double solar halo observed at this station by Mr. T. G. Shipman, August 1, 1911, at 12:10 p. m. [90th mer. time], was similar, the radius of the outer halo being 46° and the inner 22°. Its coloring was very marked and beautiful.

Dr. Louis Besson, in his article, "The Different Forms of Halos and Their Observation" (this REVIEW, July, 1914, **42**: 438-9), states that the average frequency of such phenomena at Paris is eight days per annum, and in two-thirds of the cases only the superior portion of the 46°-halo is visible. This case of the lower arc is therefore a rare one and worth recording here.

ELLIPTICAL HALOS OF VERTICAL MAJOR AXIS.

By J. B. DALE.

(Craigness, New Malden, Surrey, Apr. 10, 1918.)

[*Reprinted from* Nature, London, Apr. 18, 1918, 101: 126.]

The accepted explanation of the halos of 22° radius which are seen surrounding the sun and moon implies that they are exactly circular in form. About two years ago, however, I noticed a halo which appeared to be elliptical with the major axis vertical. I was unfortunately unable to take any measurements on that occasion, but on March 18, 1918, a lunar halo, which was visible for a considerable time during the evening, also appeared to possess a decided, though slight ellipticity. That this deviation from the circular form was not an illusion I was enabled to verify by noting the positions of Capella and γ Geminorum relative to the ring.

At 7:30 p. m. Capella appeared to be exactly upon the inner edge of the halo, while γ Geminorum was within the ring at a distance from it, which, as nearly as I could judge, was a quarter of the moon's diameter. From these data I find that the radii of the halo measured from the centroid of the illuminated disk of the moon through these two stars were 22.8° and 21.4°, respectively. Assuming that the halo was elliptical with the major axis vertical, I deduce values of 23.3° and 21.4° for the semi-major and semiminor axes. I am aware that a more or less complete halo, the major axis of which is horizontal, is occasionally seen surrounding the 22°-halo, but records of halos elongated vertically are rare. In 1908 Prof. Schlesinger noticed one, the axes of which were about 7° and 4°.

Sir Napier Shaw informs me that very little is done in this country on the shapes of halos, so that this letter may serve to direct attention to the desirability of obtaining accurate measurements.

REAL VELOCITIES OF METEORS.[3]

By CHARLES P. OLIVIER.

[*Reprinted from* Science Abstracts, Sect. A, Jan. 31, 1918, § 29.]

From a list of real flights of meteors observed by members of the British Astronomical Association (B. A. A. Journal, January, 1917), eight doubly-observed meteors are selected as assigned to a radiant near R. A. = 302°, Decl. −8°. This position is not far from the ecliptic, and appears to be a very likely example of a stationary radiant. To investigate the orbits reductions were made by Bauschinger's method, and the results are presented in a table showing the elements for each meteor orbit. Some difficulty is introduced by the importance of the duration of the time of flight, the observation of which is scarcely accurate enough when made visually, and it is hoped that systematic work may soon be done with photographic registration, apparatus having been designed for this purpose by the late Cleveland Abbe. It is concluded that the radiant under discussion is the most promising of all those hitherto examined with regard to its likelihood of being a stationary radiant.—*C. P. B[utler].*

VISIBLE WEATHER [CHINOOK WEATHER ?].

The following interesting communication, by Robert T. Pound, is reprinted from Scientific American, New York, February 16, 1918, page 147:

LAVINA, FERGUS COUNTY, MONT.
[Lat. 46° 12′ N., long. 109° W.]

On December 14 [1917], after several days of storm, my brother and I noticed that the western end of the Big Snowy Mountains, about 20 miles northwest of our place, seemed strangely distorted, the distor-

[1] Publication approved by Division of Aërological Investigations.

[2] The 46°-halo or its upper arc is not so very rare in this country. The REVIEW for July, 1914, pp. 431-436, presents in its figures 1, 3, 5, and 8, illustrations of 46°-halo seen in November, 1913; cases of the 46°-halo are also reported in the REVIEW for October, 1917, p. 486, and for May, 1915, p. 215.—*C. A., jr.*

[3] The Observatory, October, 1917, No. 518, p. 365-368.

tion extending about halfway up the mountain. On closer examination we noticed that this distortion was moving from west to east at a tremendous rate, still keeping the same height as when first observed. Because of the similarity of the waves in this effect to the heat waves sometimes seen on a hot summer day, we at once concluded that this was a chinook [sic]. The temperature when we first observed the chinook, at 10:30 o'clock, was 4° F.; the succeeding temperatures were as follows:

	°		°
10:33 a. m.	7	12:30 p. m.	26
10:50 a. m.	9	1 p. m.	30
11:05 a. m.	12	2 p. m.	34
11:35 a. m.	19	8 p. m.	33
Noon	22		

While this temperature rise is not as phenomenal as a drop of 40° in 30 minutes, which I observed on February 3, 1917, still it is of vastly more benefit to the stockman. Chinooks which occur here are invariably accompanied by a high wind from the west or northwest. Inasmuch as the generally accepted theory is that these winds come directly from the Pacific Ocean, it would be interesting to learn why only two or three chinooks, at the most, occur during a season in which 90 per cent of the winds are high and from the two above-named directions.

[The date given in this communication was one on which a chinook was blowing over the Big Snowy. There was a sharp rise in temperature amounting to as much as 40° at Havre, Mont., on the morning of December 15. From the observer's position at Lavina the Big Snowy Mountains lie directly northwest and about 20 miles distant, as he states, but without a more precise description of the nature of the distortion in the image of the mountains it is difficult to say whether the warm, dry air of the chinook actually caused it or not. Similar observations in connection with a chinook or a foehn have not come to the bureau's attention.

The present phenomenon accompanied what was undoubtedly a case of the "dry" chinook wind, a wind which is not at all related genetically to the Pacific Ocean, but derives its warm, dry nature from the forced rapid descent along the topography under the compulsion of the existing pressure distribution. See this REVIEW, April, 1907, 35:176, column 2.]

WEATHER BUREAU OBSERVATIONS IN CONNECTION WITH THE SOLAR TOTAL ECLIPSE OF JUNE 8, 1918.

By H. H. KIMBALL and S. P. FERGUSSON.

[Weather Bureau, Washington, D. C., June 19, 1918.]

The Weather Bureau observational campaign related to the solar eclipse of June 8, 1918, was planned by the authors jointly. The studies in radiation were particularly planned and executed by Prof. Kimball; while the general meteorological observations were planned and instructions prepared by Mr. Fergusson.

Radiation observations.—The Weather Bureau observations of radiation were made by Prof. Kimball at the special station established at Goldendale, Wash. (lat. 45° 50′ N.; long. 120° 48′ W.; alt., 1,650 feet[1]). There he installed a Smithsonian pyranometer for measuring the intensity of both the direct solar radiation and the diffuse sky radiation; and also a pyrgeometer of the Ångström type, for measuring the intensity of the outgoing radiation at night and also during totality. Observations with the pyranometer were commenced June 4, 2 p. m., 105th meridian time, and continued at frequent intervals each day until 8 p. m. of June 8. Observations with the pyrgeometer were made each night from June 4–5 to June 9–10; those on the night of June 4–5 continued at frequent intervals from 8 p. m. to 4 a. m., on other nights they were generally made between 8 and 11 p. m. The pyranometer was also employed in measuring outgoing radiation.

Near the radiation apparatus was installed an instrument shelter screening a thermograph, hygrograph, maximum and minimum thermometers. Continuous records of temperature and humidity were obtained from June 4, noon, to June 10, 10 a. m.; and were supplemented by eye readings of an Assmann ventilated and of a sling psychrometer at hourly intervals from 9 a. m. to 6 p. m. each day.

At the same hours a record was made of direction and force of the wind, and the kind, amount, and direction of clouds.

On June 8, for an hour preceding and following the total phase of the eclipse, the wind, cloud, and psychrometer observations were made at 10-minute intervals.

During totality excellent measurements were obtained of the intensity of outgoing radiation.

Meteorological observations.—The program of meteorological observations was based chiefly on certain results of studies by Clayton, Bigelow, and others of the eclipses of May 28, 1900, and August 30, 1905. The field work was limited to observations of atmospheric pressure and temperature, direction of wind, clouds, and shadow-bands. On the day of the eclipse special observations of pressure, temperature, wind, and clouds were made every half hour, beginning at noon and ending with the last regular telegraphic observation of the day. From an hour before until an hour after totality, however, the observations were made every 10 minutes. In order to allow for local changes of any kind, additional observations of wind direction were made at corresponding hours daily from June 3 to 15, inclusive. Pressure observations were careful eye-readings of a mercurial barometer, and wind observations were of a vane reflected in the mirror of a nephoscope, thereby permitting determination of direction to less than 5° of arc.

These observations were made at about 55 stations, nearly all located west of the Mississippi and within the zone of 90 per cent obscuration. Pressure was observed at 45 stations; temperature at 15; clouds at 36; and wind direction at 17.

Continuous records of temperature, pressure, and wind velocity are, of course, available from a number of regular stations of the Weather Bureau within and near the path of totality. Special instructions for observing shadow-bands were sent to many regular and cooperative observers suitably located.

The reports of these special meteorological observations are now coming in rapidly and indicate generally that partly cloudy or cloudy weather prevailed throughout and near the path of totality as far eastward as special observations were made. Probably this condition of the sky seriously interfered with observations of shadow-bands.

[1] Based on local railroad determination.